



U.S. DEPARTMENT OF
ENERGY

Hydrogen Stakeholder Webinar

National Clean Hydrogen Strategy and Roadmap and Interagency Coordination

August 18, 2023





THE WHITE HOUSE
WASHINGTON

Welcome Remarks

Deputy National Climate Advisor to the President

Mary Frances Repko

Introduction

Deputy Secretary of Energy David Turk

National Clean Hydrogen Strategy and HIT Deep Dive

Dr. Sunita Satyapal

Director, Hydrogen and Fuel Cell Technologies Office, DOE

DOE Hydrogen Program Coordinator,

and HIT Director

U.S. National Clean Hydrogen Strategy and Roadmap

Strategy



1

Target strategic, high-impact end uses

Achieve 10 MMT/year of clean hydrogen by 2030



2

Reduce the cost of clean hydrogen

Enable \$2/kg by electrolysis by 2026 and \$1/kg H₂ by 2031



3

Focus on regional networks

Deploy regional clean hydrogen hubs and ramp up scale

Vision:

Affordable clean hydrogen for a net-zero carbon future and a sustainable, resilient, and equitable economy

Benefits:

Emissions reduction; job growth; energy security and resilience

Work with other agencies to accelerate market lift off

Enablers



Good Jobs and Workforce Development



Safety, codes and standards



Policies and incentives

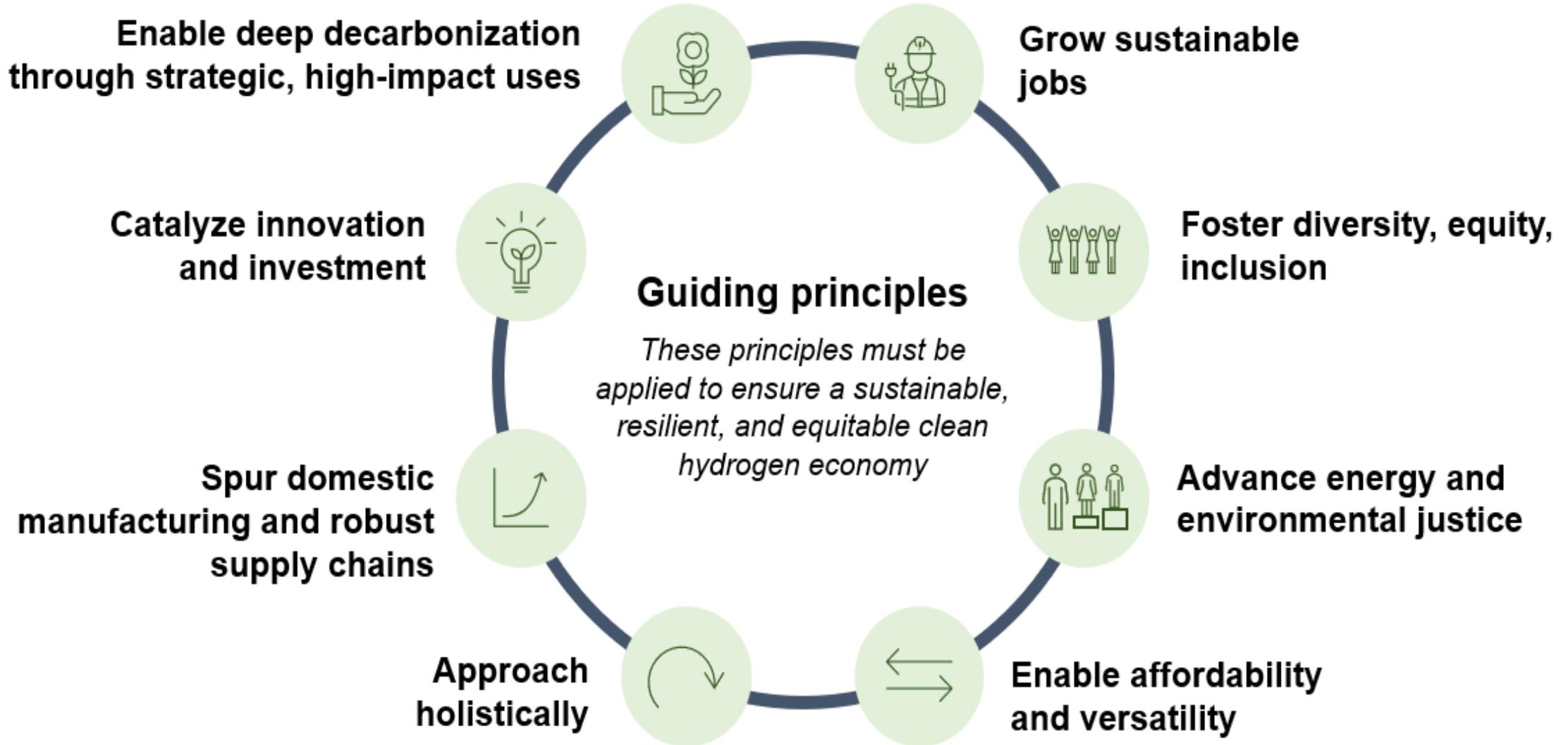


Stimulating private sector investment



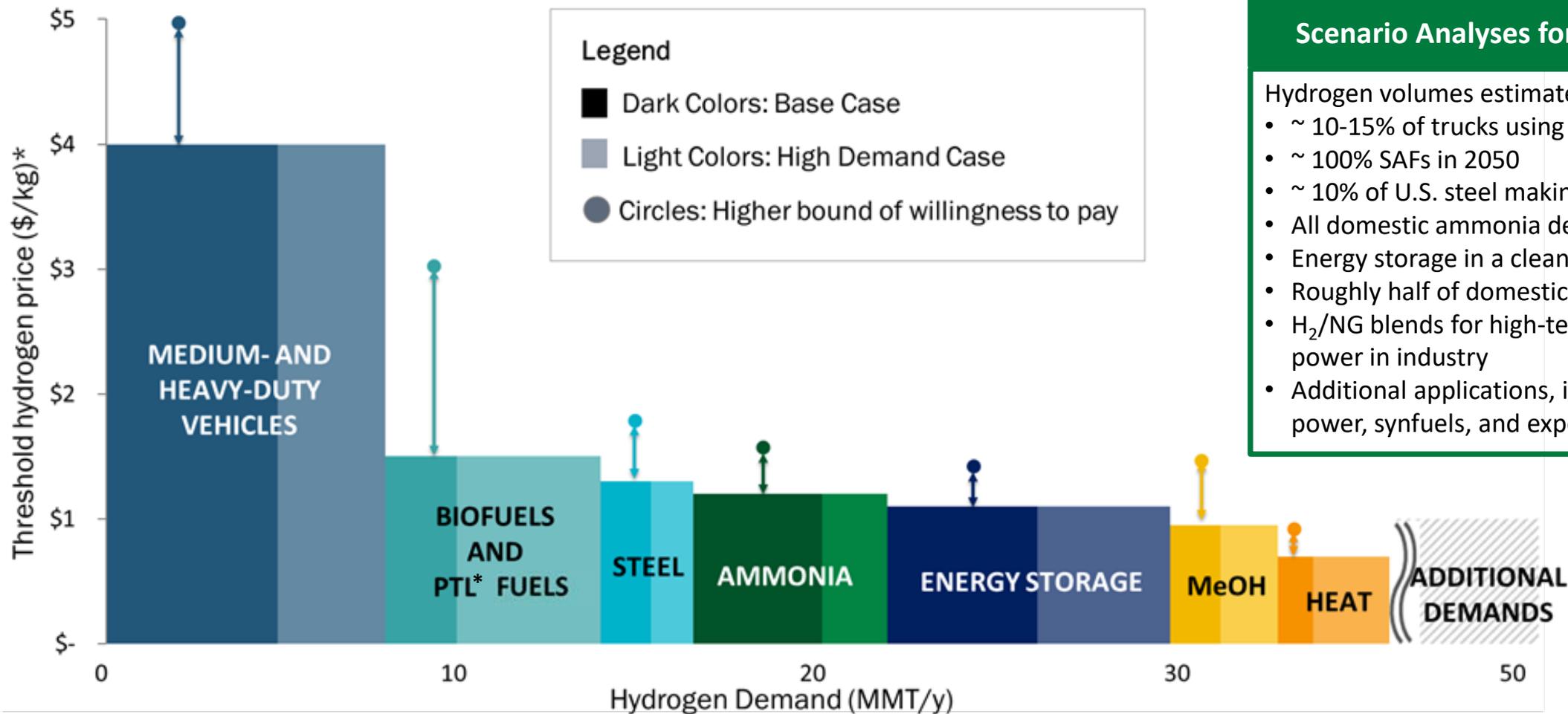
Energy and environmental justice

Guiding Principles



Strategy 1: Target High-Impact Uses of Hydrogen

Clean Hydrogen Demand and Costs for Market Penetration



Scenario Analyses for H₂ Demand**

Hydrogen volumes estimated for:

- ~ 10-15% of trucks using fuel cells
- ~ 100% SAFs in 2050
- ~ 10% of U.S. steel making
- All domestic ammonia demand
- Energy storage in a clean grid
- Roughly half of domestic methanol
- H₂/NG blends for high-temp heat and power in industry
- Additional applications, include stationary power, synfuels, and export potential

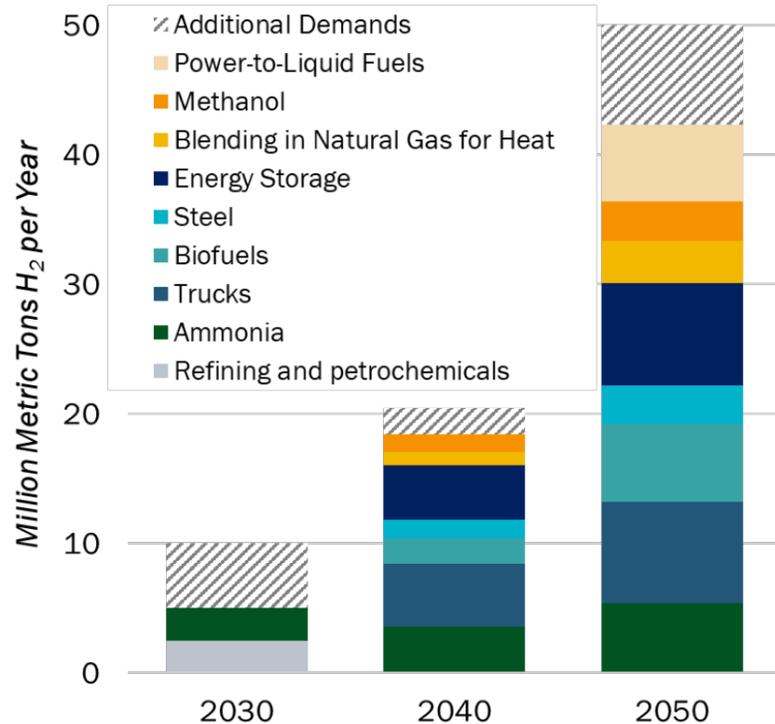
Costs include production, delivery, dispensing to the point of use (e.g., high-pressure fueling for vehicle applications)

* Power to Liquid

** Volumes dependent on multiple variables

Strategy 1: Target High-Impact Uses of Hydrogen

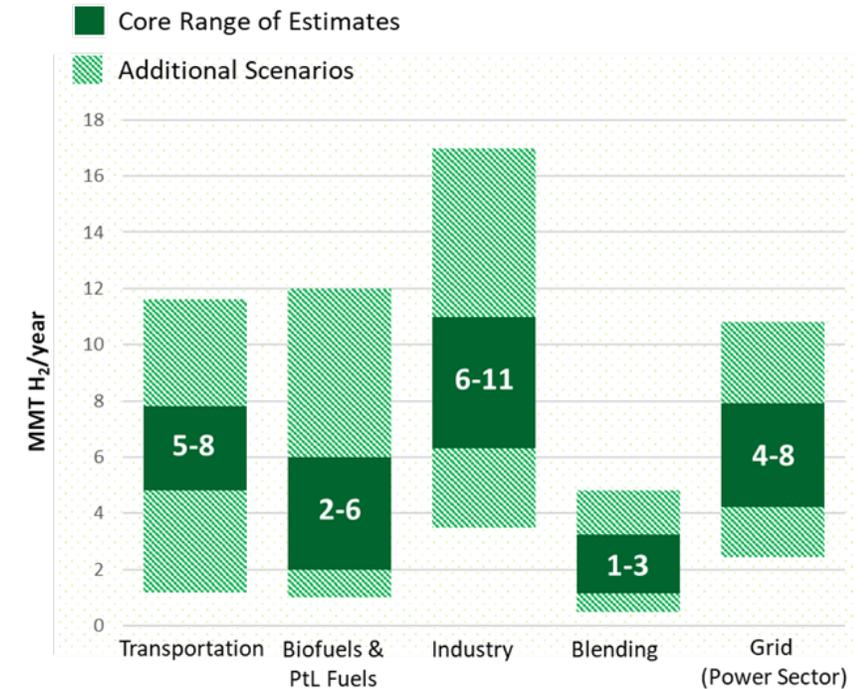
Opportunities for Clean Hydrogen Across Applications



Clean Hydrogen Use Scenarios

- Catalyze clean H₂ use in existing industries (ammonia, refineries), initiate new use (e.g., sustainable aviation fuels (SAFs), steel, potential exports)
- Scale up for heavy-duty transport, industry, and energy storage
- Market expansion across sectors for strategic, high-impact uses

Range of Potential Demand for Clean Hydrogen by 2050



• **Core range:** ~ 18–36 MMT H₂

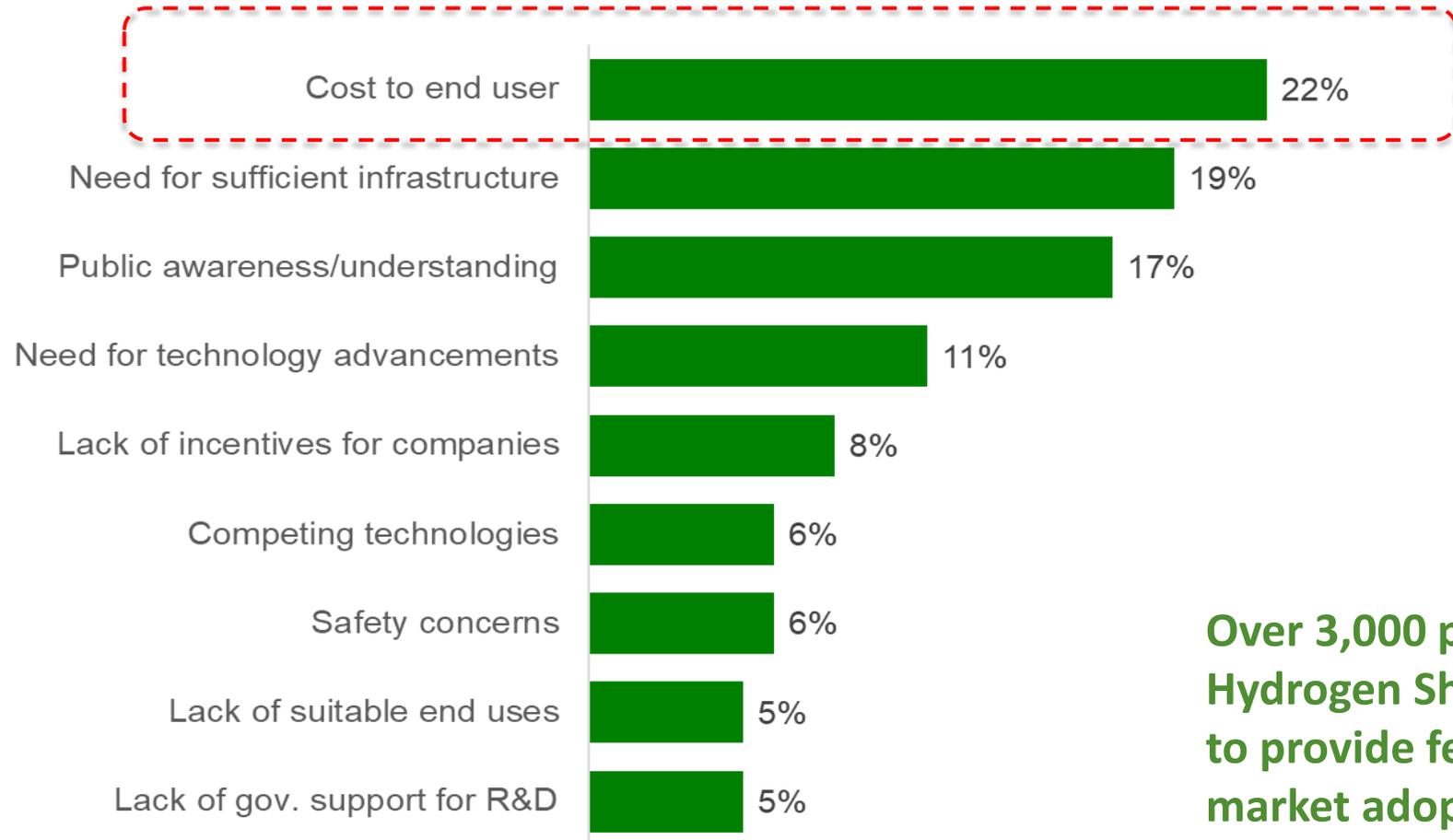
• **Higher range:** ~ 36–56 MMT H₂

U.S. Opportunity: 10MMT/yr by 2030, 20 MMT/yr by 2040, 50 MMT/yr by 2050. ~10% Emissions Reduction. ~100K Jobs by 2030.

Refs: 1. NREL MDHD analysis using TEMPO model; 2. Analysis of biofuel pathways from NREL; 3. Synfuels analysis based off H2@Scale; 4. Steel and ammonia demand estimates based off DOE Industrial Decarbonization Roadmap and H2@Scale. Methanol demands based off IRENA and IEA estimates; 5. Preliminary Analysis, NREL 100% Clean Grid Study; 6. DOE Solar Futures Study; 7. Princeton Net Zero America Study

Strategy 2: Focus on Cost-Reduction

Stakeholder Reported Barriers to Hydrogen Market Adoption



Over 3,000 participants at DOE Hydrogen Shot Summit were requested to provide feedback on key barriers to market adoption of hydrogen

Source: Hydrogen Shot Summit, Sept 2021

<https://www.energy.gov/eere/fuelcells/hydrogen-shot-summit>



Hydrogen

Hydrogen Energy Earthshot

“Hydrogen Shot”

“1 1 1”

\$1 for 1 kg clean hydrogen in 1 decade

Launched June 7, 2021

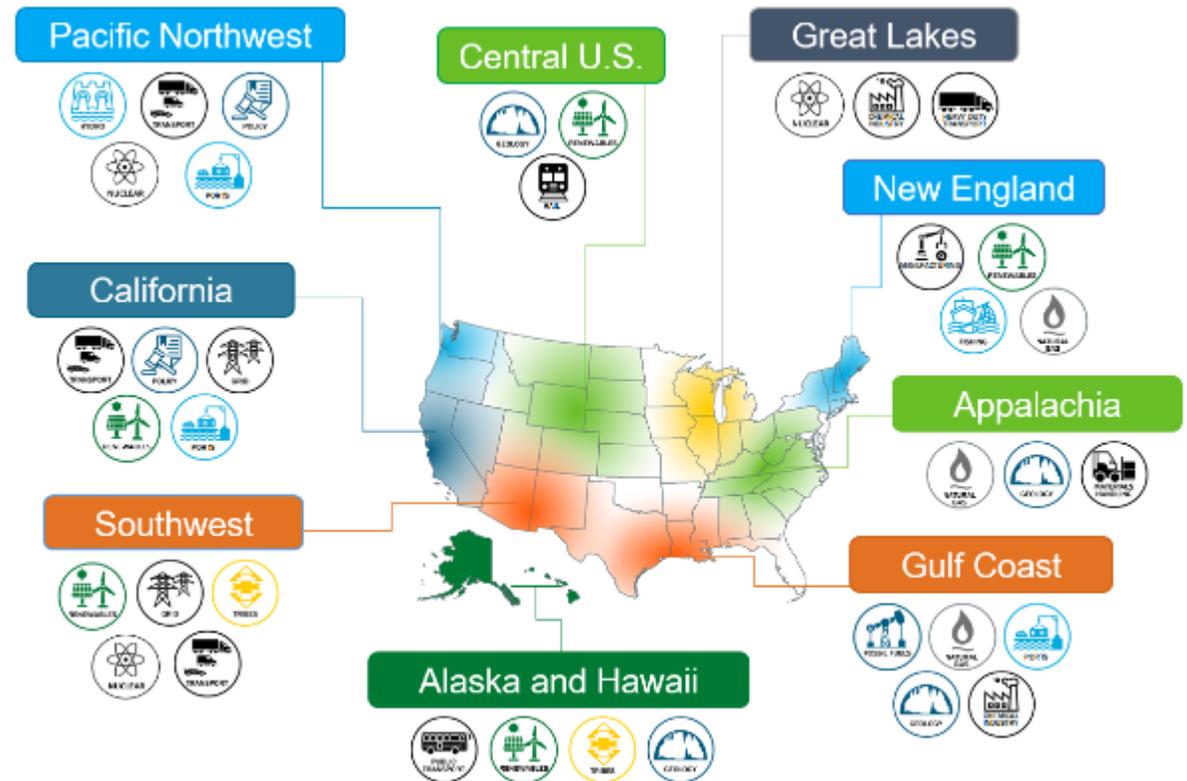
Strategy also includes hydrogen delivery and storage

Strategy 3: Focus on Regional Networks and Ramp Up Scale

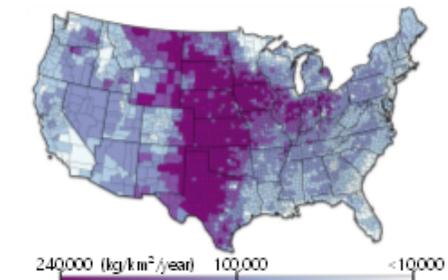
Build Regional Networks through “Clean Hydrogen Hubs”



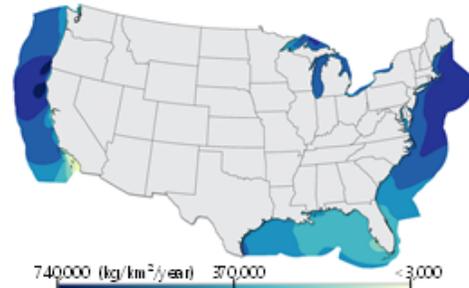
Examples of Stakeholder and RFI Input



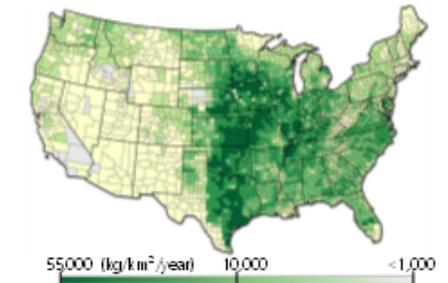
Analysis of Potential Supply Resources and Underground Storage



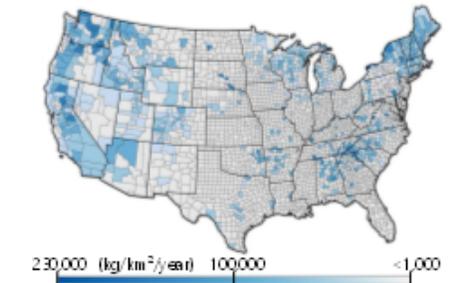
a) *Hydrogen production potential from onshore wind resources, by county land area*



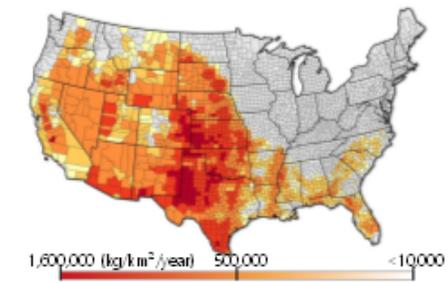
b) *Hydrogen production potential from offshore wind resources, by area*



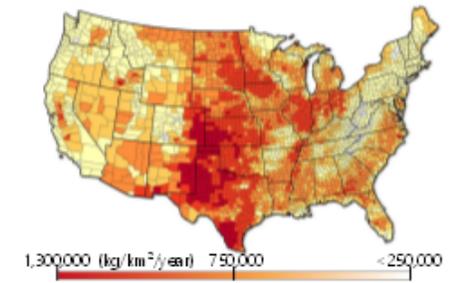
c) *Hydrogen production potential from solid biomass resources, by county land area*



d) *Hydrogen production potential from existing hydropower assets, by county land area*

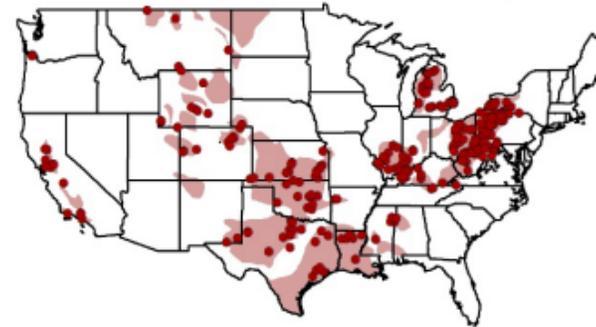


e) *Hydrogen production potential from concentrated solar power, by county land area*

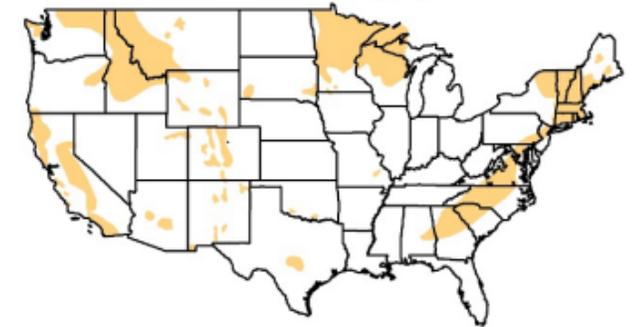


f) *Hydrogen production potential from utility-scale PV, by county land area*

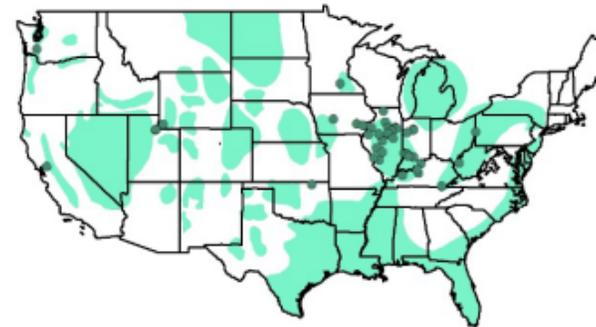
a) Oil & Gas Fields and Depleted Field Natural Gas Storage Facilities



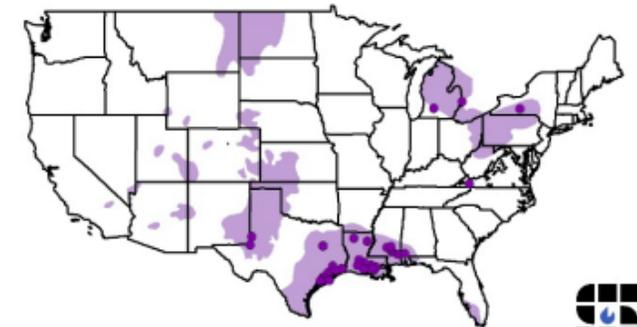
b) Hardrock Outcroppings



c) Sedimentary Basins and Aquifer Natural Gas Storage Facilities



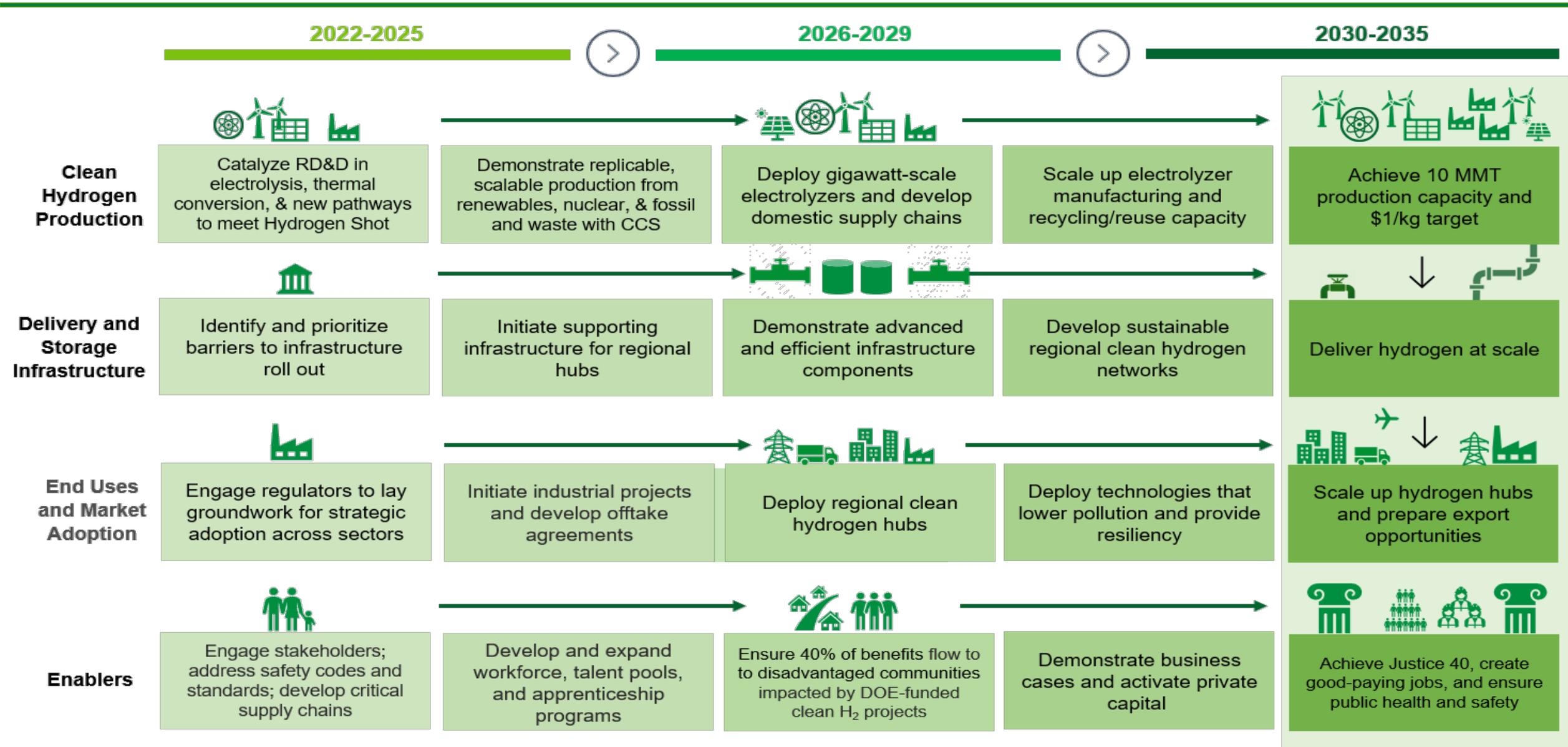
d) Salt Deposits and Salt Dome Natural Gas Storage Facilities



Source: NREL, Lab analysis, National Strategy

Source: SHASTA, NETL

Actions and Timelines



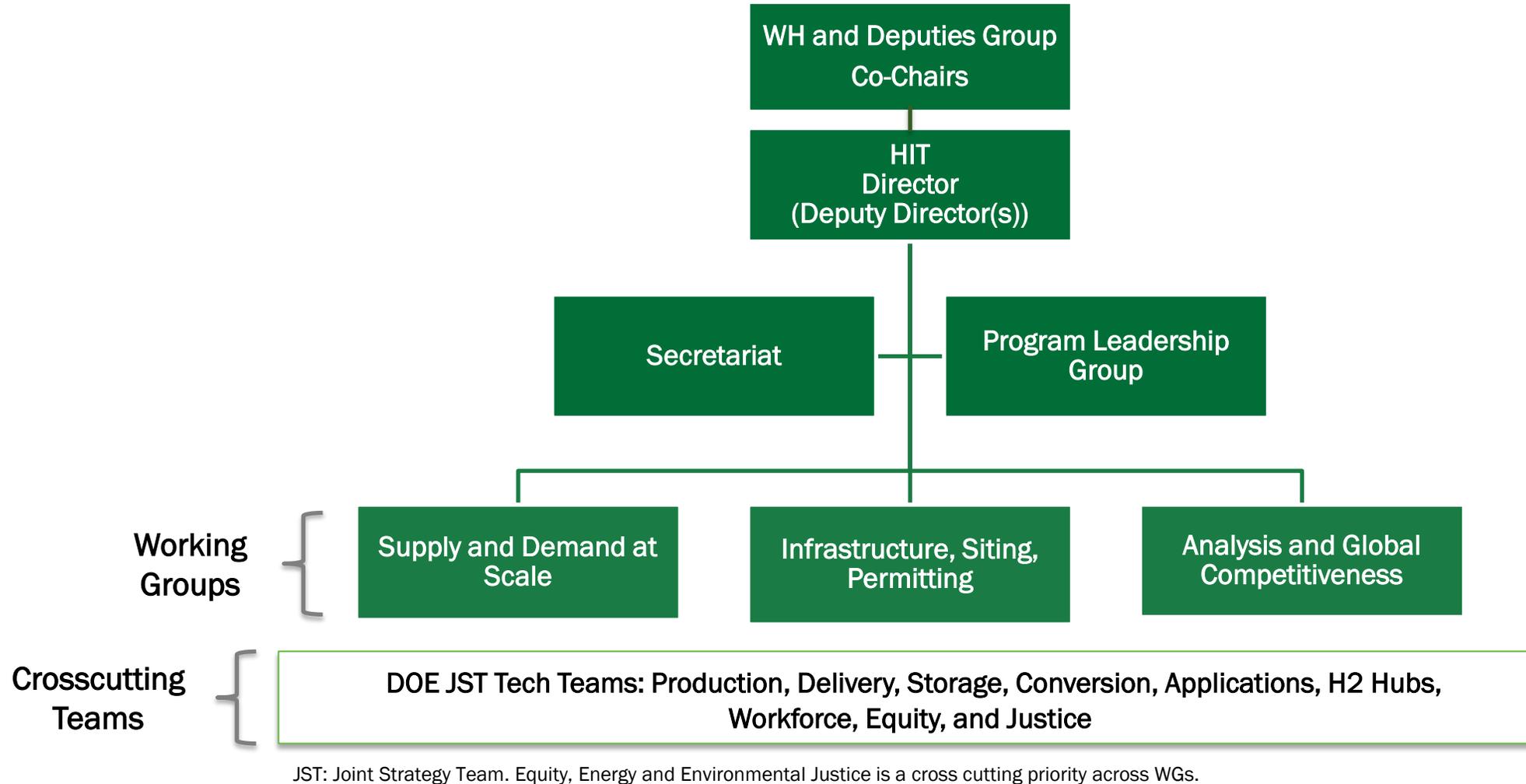
Whole-of-Government Approach

HIT

Hydrogen Interagency Task Force

H₂

Hydrogen Interagency Task Force (HIT) across 11 Agencies



The Energy Policy Act of 2005 authorized the establishment of an interagency task force on hydrogen and fuel cells. 42 U.S.C. 16155. Agencies have been collaborating under the existing IWG and are working to expand collaboration by developing a Hydrogen Interagency Taskforce. More details will be available on www.hydrogen.gov.

HIT Working Group Structure and Focus Areas

Enable National Goals: 10 MMT/yr supply and end use by 2030, 20 MMT/yr by 2040, 50 MMT/yr by 2050

Working Groups

Supply and Demand at Scale

- Enabling large scale production and demand creation
- Financing, incentives, and compliance tools for commercial scale up
- Metrics for deployment and USG as offtaker
- Supply chains and resiliency (critical materials, strategic reserve)
- R&D to accelerate cost reductions and end use commercialization (JST interface)

Infrastructure, Siting, Permitting

- Siting, permitting, pipelines, storage, and infrastructure
- Harmonized codes and standards
- Interoperability and global standardization
- Safety, emissions (including secondary), sensors, risk mitigation, environmental impact
- Environmental review and best practices (NEPA, etc.)
- Pipeline and blending test facilities

Analysis and Global Competitiveness

- National strategy and commercial liftoff analysis
- Impacts and gap assessments (technoeconomic analysis, incentives, resource/water availability, emissions, jobs, manufacturing, etc.)
- Intellectual property and global landscape assessment
- Export market analysis
- Systems integration and optimization

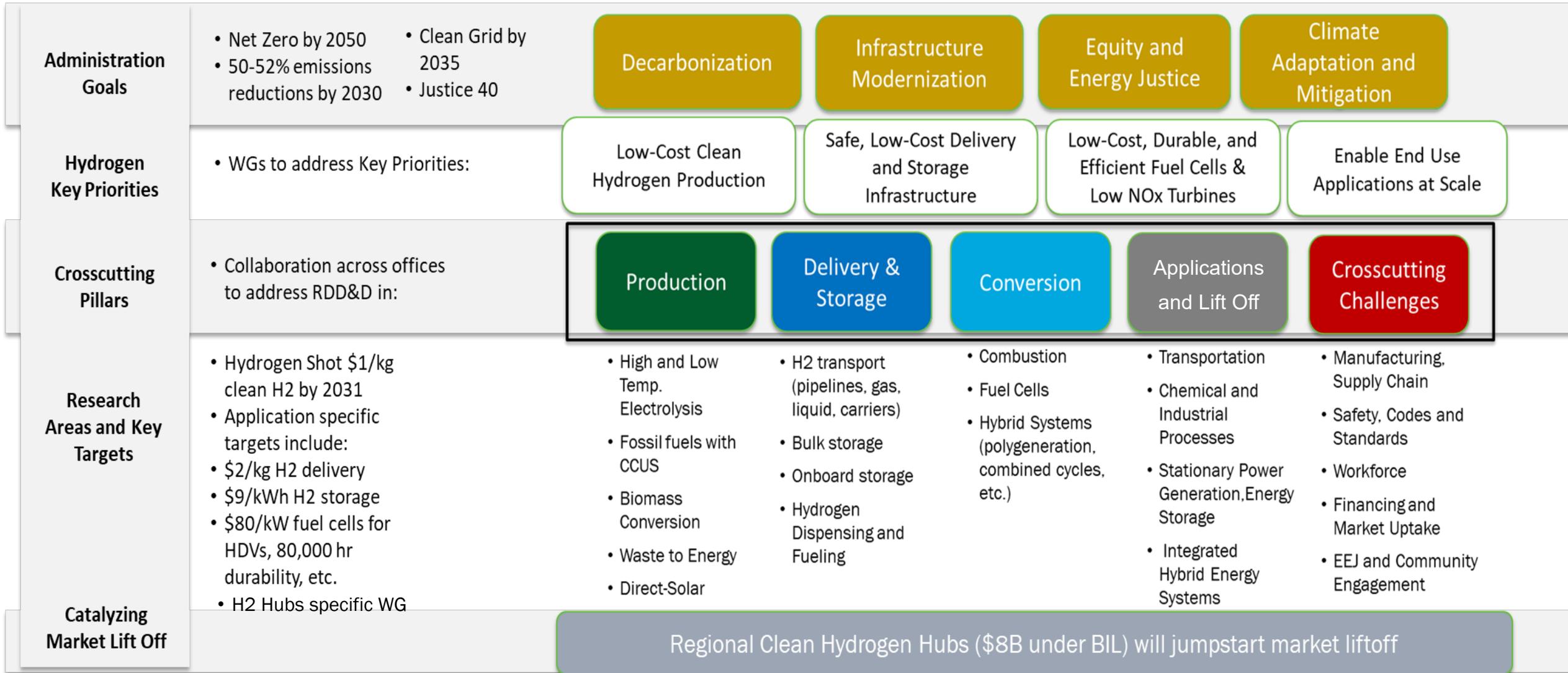
Crosscutting Teams

DOE JST Tech Teams: Production, Delivery, Storage, Conversion, Applications, H2 Hubs

Workforce, Equity, and Justice

DOE Joint Strategy Team (JST) Tech Teams will include agency members as appropriate. Each team includes expertise in manufacturing and knowledge management.

Hydrogen Joint Strategy Team



Multiple offices across DOE and coordination across agencies

Hydrogen: Arctic Perspective

Dr. Erin Whitney

Director of the Arctic Energy Office, DOE

Example: Alaska Hydrogen Working Group

- Led by the Arctic Energy Office, which coordinates cross-cutting DOE work in Arctic to address energy, science, and national security.
- Covers green shipping corridor, Iceland-Alaska knowledge sharing, clean methanol production, engine permitting, and more.
- Drafting an opportunities report for the State of Alaska, with NREL tech support.



Hydrogen: Deploy and Liftoff

Todd Shrader

**Director, Project Management,
Office of Clean Energy Demonstrations, DOE**



Regional Clean Hydrogen Hubs

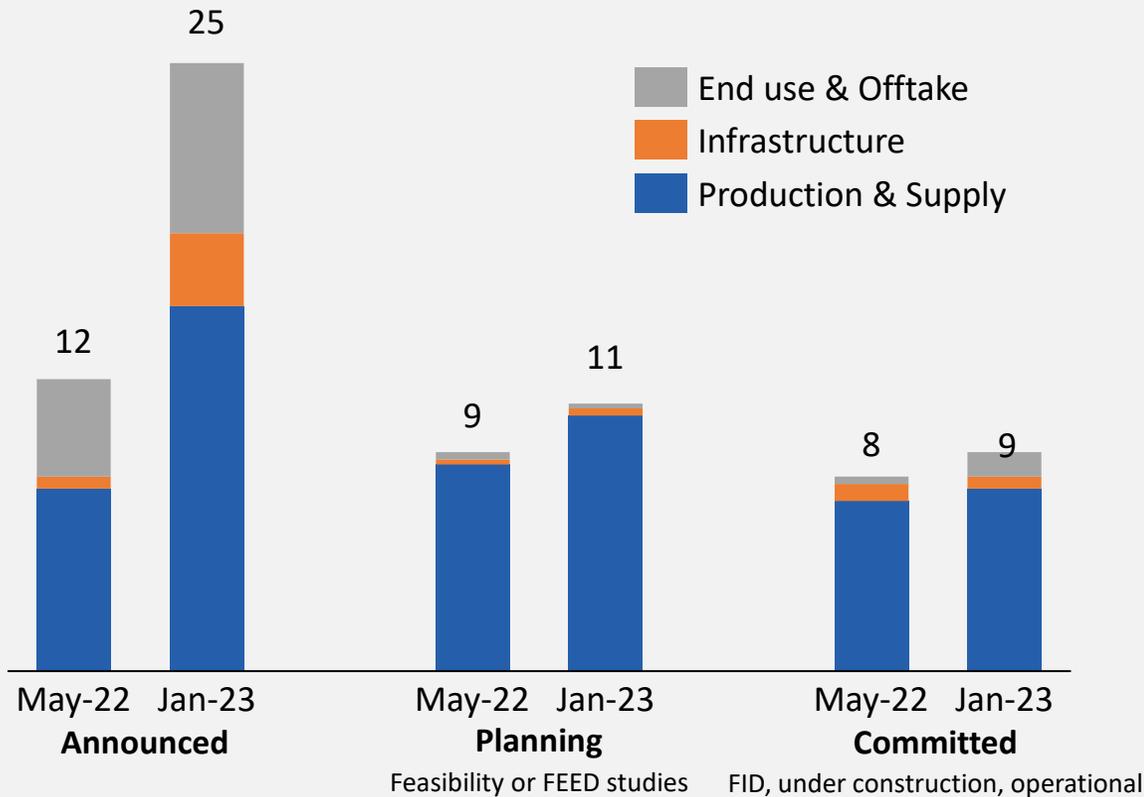
OCED and Industry awardees will build 6-10 regional clean H2Hubs across the country to create networks of hydrogen producers, consumers, and local connective infrastructure to accelerate use of hydrogen.

- Feedstock diversity
- End use diversity
- Geographic diversity
- Employment and training
- Connecting diverse parties to facilitate clean energy business interactions
- Understanding the role clean hydrogen could play in the energy transition
- Real-world context for hydrogen demand and supply
- De-risking technical questions (e.g., sensors, storage, transport) that will allow industry to use higher blended rates of hydrogen

Current Status

- Released funding announcement in September 2022
- Held webinar with encouraged/discouraged applicants in January 2023
- Full applications received April 7, 2023
- Selections in Fall 2023

Hydrogen lacks the bankable demand needed to move from announcements to steel in the ground



North American direct hydrogen investments through 2030 in \$Billions

To reach FID, investors require offtake agreements and financeable structures

Stakeholder Feedback Examples

Recent federal incentives may not create adequate demand to drive national hydrogen market formation; additional policy and regulatory actions are needed.



Today, investments in production outpace offtake, and many offtakers are hesitant to sign long-term contracts.



Key findings of the Clean Hydrogen Liftoff Report



PTC reduces production costs to kick-start the transition from high carbon intensity (CI) to low CI hydrogen for existing uses



DOE H2Hubs and open access infrastructure will move use cases into the money that would otherwise not take-off



In addition to industrial/chemicals use cases, heavy-duty transportation will be critical for market lift-off



Without sustained long-term offtake or merchant markets, domestic market acceleration could be slowed

H2 Liftoff Report: [About the Pathways Reports - Pathways to Commercial Liftoff \(energy.gov\)](https://www.energy.gov/about-the-pathways-reports-pathways-to-commercial-liftoff)



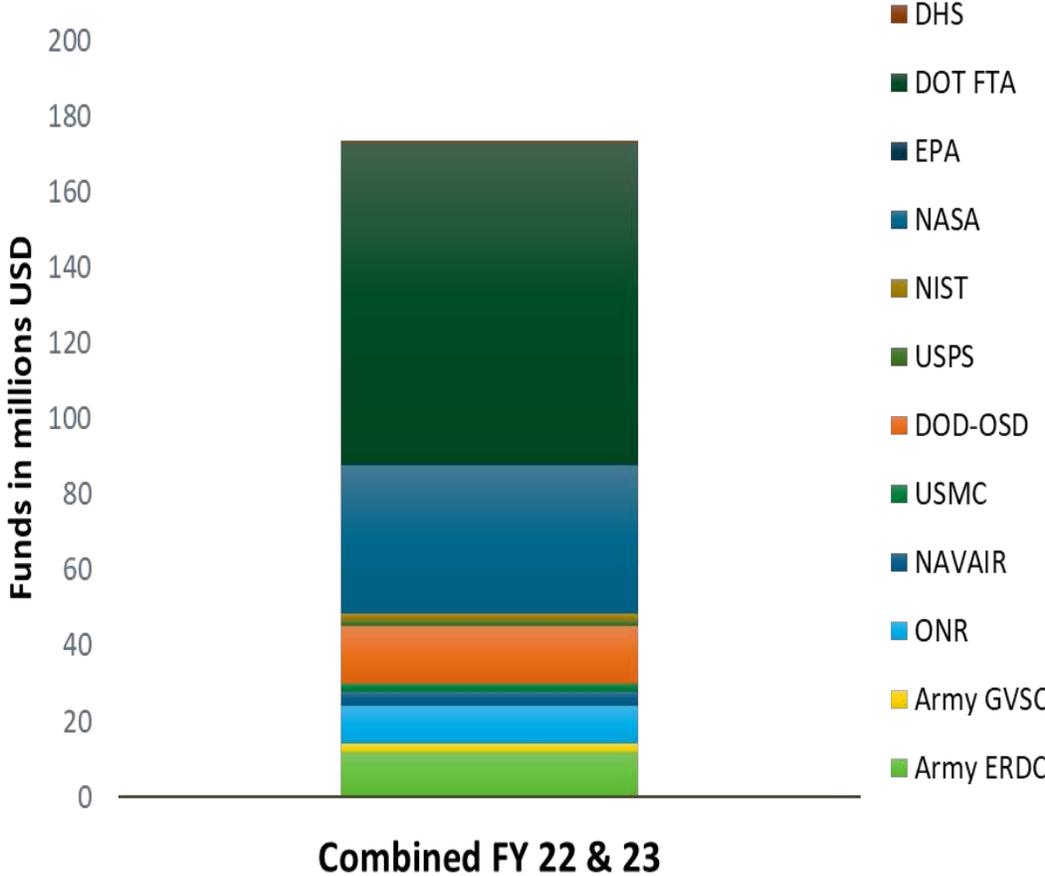
Hydrogen: Inter-Agency Collaboration

Dr. Sunita Satyapal
HIT Director

Cross Agency Hydrogen Activities - Examples

Partners	Examples of Collaborations & Focus Areas
DOT, DOE	Pipelines, buses, marine, fueling corridors
DOD, DOE, DHS across services	H2Rescue Truck, vehicles, infrastructure, UAVs, UUVs, soldier power, microgrids, and more
DOE, USPS	FC lift trucks and hydrogen infrastructure
NASA, DOE, NSF	Cryogenics/LH2, fuel cells, electrolyzers, storage, DOE consortia (NSF)
DOC (NIST), DOE	Metering, diagnostics, supply chain, blends, standards
EPA, DOE, et al	Proposed rulings (EPA), emissions analysis, ports
USDA	REAP and rural community programs

Additional Federal Agency Hydrogen and Fuel Cell Funding - FY 22 & 23



Environmental Protection Agency (EPA)

**Stephanie Grumet
Senior Policy Advisor
Office of Air Quality Planning and Standards**

EPA Regulatory Proposals and Ports Program Drive Hydrogen Demand



Proposed Rule to Control Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards

EPA considered H₂ fuel cell technology for select applications that travel long distances or carry heavy loads



Proposed Carbon Pollution Standards for Fossil Fuel-Fired Power Plants: one path to BSER for new and existing turbines include:

30% cofiring low-GHG H₂ by 2032
96% cofiring low-GHG H₂ by 2038



\$3 billion Clean Ports Initiative authorized by IRA

EPA will provide funding for zero-emission port equipment, technology and to help ports develop climate action plans.

<https://www.epa.gov/inflation-reduction-act/clean-ports-program>

EPA is introducing hydrogen as a decarbonization measure across multiple sectors.

Department of Transportation
Pipeline and Hazardous Materials and Safety Administration

Mary McDaniel
Acting Director
Engineering & Research Division

DOT Rulemaking Initiatives

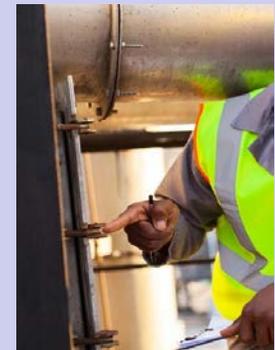
Rupture Detection and Valve Final Rule Published 4/8/2022

- Improve the timeliness of rupture identification, response, and mitigation of safety, greenhouse gas, and environmental justice impacts.
- Establishes requirements for rupture-mitigation valve spacing, maintenance and inspection, and risk analysis.
- Requires operators to identify ruptures and close valves to isolate the ruptured segment as soon as practicable, not to exceed 30 minutes from rupture identification.



Leak Detection and Repair Notice of Proposed Rule 5/18/2023

- Applies to nearly 3 million miles of pipelines; all underground natural gas storage, and LNG facilities.
- Reduce intentional and unintentional emissions from new and existing pipelines
- Requires operator to provide for the timely identification and repair of all leaks.



Hydrogen Research

Technology Development

Solutions for Predicting /
Monitoring Hydrogen Gas Loss

General Knowledge

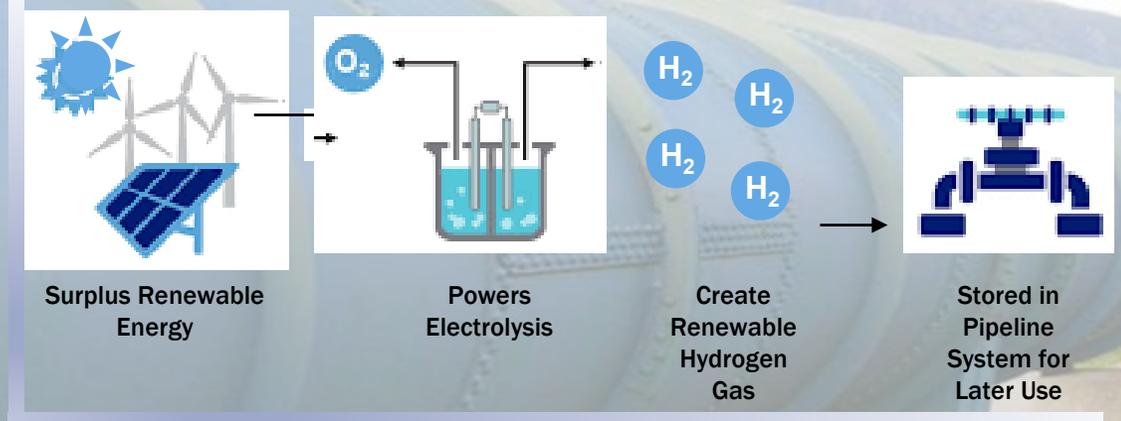
Review of Integrity Threat
Characterization Resulting from
Hydrogen Gas Pipeline Service

Technology Development

Advancing Hydrogen Gas Leak
Detection Tools when Blended with
Natural Gas Pipeline Operations

General Knowledge

Determining Requirements for
Repurposing Existing Pipelines to
Transport Blended & Pure Hydrogen



Technology Development

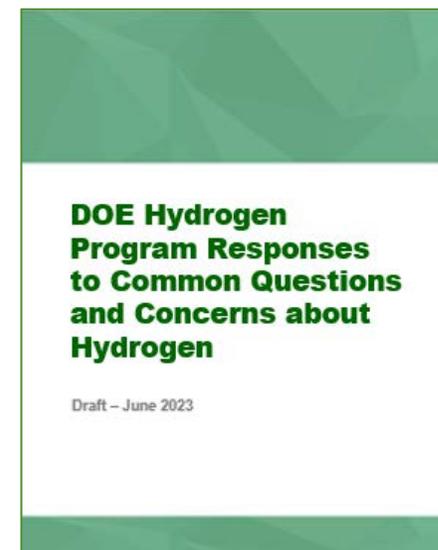
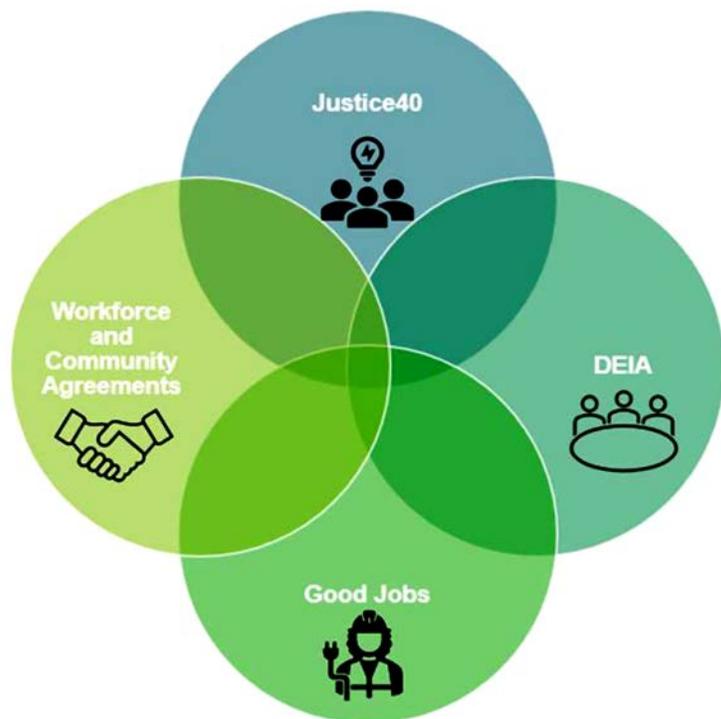
Validate Existing or Develop New Hydrogen
Leak Detection Sensors Compatible with
Hydrogen-Natural Gas Blends



Hydrogen: The Equity and Environmental Justice Perspective

Dr. Sunita Satyapal

Equity and Environmental Justice Perspectives



Stay tuned for more information on **Community Benefits Plans, Mapping Tools, and upcoming activities**

Hydrogen: Upcoming Events and Ways to Engage



HYDROGEN AMERICAS 2023 SUMMIT & EXHIBITION

2 – 3 OCTOBER 2023

RONALD REAGAN INT. TRADE CENTER,
WASHINGTON D.C.

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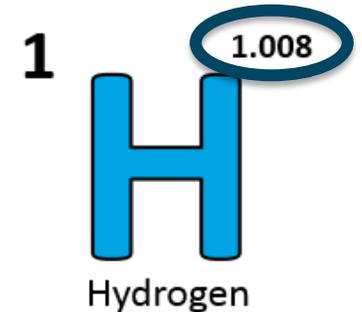
Resources and Opportunities for Engagement

Save the date!

**2024 DOE Annual Merit Review
and Peer Evaluation Meeting
May 6-9, 2024**

**Hydrogen and Fuel Cells Day
October 8**

- Held on hydrogen's
very own atomic
weight-day



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Thank you!

www.hydrogen.gov

Questions?